

**Main Office**

**10060 Goethe Road**  
**Sacramento, CA 95827-3553**  
**Tele: [916] 876-6000**  
**Fax: [916] 876-6160**

**Sacramento Regional Wastewater  
Treatment Plant**

**8521 Laguna Station Road**  
**Elk Grove, CA 95758-9550**  
**Tele: [916] 875-9000**  
**Fax: [916] 875-9068**

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September 30, 2011

Delta Stewardship Council  
980 9th Street, Suite 1500  
Sacramento, CA 95814

*Sent via e-mail: [deltaplancomment@deltacouncil.ca.gov](mailto:deltaplancomment@deltacouncil.ca.gov)*

**Subject: Sacramento Regional County Sanitation District's Comments  
Regarding Fifth Staff Draft Delta Plan Dated August 2, 2011**

Dear Chairman Isenberg and Council Members:

The Sacramento Regional County Sanitation District (SRCSD) is providing the following comments and suggested language changes for the Fifth Staff Draft Delta Plan (Fifth Draft) released on August 2, 2011. SRCSD appreciates the Delta Stewardship Council's (Council) recognition that the Delta Plan will be an evolving plan over time, informed by science, adaptive management, and applicable law and policy. The Fifth Draft is a dramatic improvement over previous drafts. However, as noted in previous comment letters to the Council, we still have a number of concerns that we are requesting to be addressed in the Sixth Draft. Our overarching concerns are outlined below, while our detailed comments and suggested language changes are included in Attachment 1. In general, SRCSD has concerns with the following aspects of the Fifth Draft:

- Governance - Redundant Regulatory Actions
- Water Quality - Best Available Science
- Finance Plan Framework - Funding Mechanisms for the Delta Plan

**Redundant Regulatory Actions**

Clearly identifying what is a covered action is important to the Council and project proponents. Water Code Section 85057.5(b) states that a covered action does not include a regulatory action of a state agency. Accordingly, clarifying language must be included and examples provided in the Delta Plan that state any project(s) undertaken to comply with a regulatory action of a state agency should not be considered "covered actions" and are exempt from consistency determinations, such as the issuance of a NPDES permit by a Regional Water Quality Control Board, a California Endangered Species Act take permit or Natural Community Conservation Plan issued or approved by the Department of Fish and Game. The redundancy of having a project required as part of a regulatory action by a State Agency being subject to a consistency determination, with all the potential for an appeal of the Council's decision, will increase project costs, result in project delays and impede the achievement of the co-equal goals of water supply reliability and ecosystem restoration.

In addition, the Plan appears to have redundant requirements that are already under the CEQA process. GP 1 states that covered actions must disclose potentially significant adverse environmental impacts and feasible mitigation of those adverse impacts. Because the consistency determination requires this duplicate process, it would allow an opponent of the covered action the ability

to allege non-compliance with CEQA through appeal of a consistency determination. As a result, the policy would create a second opportunity for CEQA challenges on the adequacy of environmental review after a local agency's completion of CEQA documents. Again, this creates the potential for additional project delays and significant cost ramifications. We have suggested language changes in our attached specific comments that would eliminate these redundant CEQA challenges.

#### Water Quality- Best Available Science

The Water Quality chapter is greatly improved. However, there are still some misleading and inaccurate statements regarding drinking water quality, nutrients, and other contaminants, as well as unrealistic timelines to complete required research, studies and, if necessary, relevant regulations. These comments are detailed in Attachment 1. For instance, consistent with the Independent Science Board's review of the Fifth Draft, we recommend more discussion on drinking water quality. The discussion should include the most recent results of technical studies completed by the Central Valley Drinking Water Policy Workgroup. Recent reports prepared by West Yost Associates and Malcolm Pirnie, available on the Central Valley Regional Water Boards website, should be reviewed to obtain the current understanding of costs to treat Delta water to meet current Safe Drinking Water Act requirements and the presumption that population growth in the Delta watershed will pose a future threat to drinking water quality. These reports specifically identify that drinking water treatment plants are currently built to handle water quality conditions that are not expected to vastly change in the future. Current Clean Water Act regulations and NPDES permit requirements will more than offset the incremental increases in pollutant loads associated with population growth.

The pathogen discussion regarding the risk of disease in Delta waters is also inaccurate. Available pathogen data for the Delta collected by water agencies under the Information Collection Rule indicates that regulatory thresholds are neither exceeded nor threatened to be exceeded.

#### Finance Plan Framework-Funding Mechanisms for the Delta Plan

SRCS D appreciates language in the Fifth Draft suggesting a strong role for stakeholder involvement in the development of short and long-term financing plans. We also appreciate language suggesting the Delta Stewardship Council's commitment to incorporating strong scientific analysis into all financing plan discussions.

However, SRCS D still has significant concerns with the current Finance Plan Framework and our previous comments submitted on June 23, 2011 are still relevant. The successful development and implementation of Delta ecosystem and water supply policies – and associated financing mechanisms in particular – require consideration of several critical principles. First, the finance plan must include clear delineation of major programmatic and project specific funding needs and a broad and inclusive analysis of potential funding sources. Second, the selection of actions needed to support Delta goals must be based on sound business perspectives to prioritize where money will be spent. Cost benefit or return on investment type approaches are essential in determining where value is created thereby enabling priorities to be set. Third, any assignment of costs must be equitable and based on a clear nexus between the paying entity and the program expenditure. And lastly, investments towards compliance with regulatory requirements should be accounted for in any fee structure.

We all recognize that additional funding mechanisms need to be developed. However, to accomplish this enormous task, the finance plan should be phased and follow an adaptive management approach. The first phase should focus immediately on meeting short term needs, while the second phase should refine the variety of long term funding options available as the specific projects and costs become clearer. For

instance, the ability to determine the proportion of benefits received or stresses caused, will be arduous, time consuming, and most likely will not fulfill any near term funding needs of the Council, the Delta Conservancy (Conservancy), and the Delta Protection Commission (Commission). These initial costs may be better suited for broad public funding.

Assessing a fee on wastewater treatment plants provides an example of the complexity of assessing stressor fees. The Clean Water Act is effectively a stressor pays program. NPDES permittees effectively “pay” by complying with regulatory requirements that require investments in capital and operational enhancements to mitigate their impacts, and as a result, beneficial uses of water are protected. Therefore, any stressor fees applied should be based on the degree to which the stressor is affecting beneficial uses. For discharges to the watershed (point and non-point), stressor fees should not be based on the volume of contaminants discharged, but rather based on the degree to which pollutant loading affects beneficial uses.

In summary, the Finance Plan chapter should clearly identify all sources of funding (existing and proposed) that will be used to finance programs and projects in the Delta, not just suggest new fees on a select few entities to support the Council, Conservancy, and Commission’s operations. In addition, we recommend that the Delta Plan include a more detailed outline of the fee authorization framework, as well as the public review process, that would include legislative oversight. As currently written, the proposed Finance Plan Chapter provides too much discretion to the Council in establishing a fee structure and does not fairly evaluate all potential funding possibilities.

We will be providing the Council via a separate letter some key fundamental principles SRCSD believes must be considered when developing the Finance Plan for the sixth draft of the Delta Plan. We hope you find our attached specific comments with recommended language changes useful for developing the sixth draft. If the Council or staff has any questions about these comments, please contact me at [mitchellts@sacsewer.com](mailto:mitchellts@sacsewer.com) or 916-876-6092 or Linda Dorn, [dornl@sacsewer.com](mailto:dornl@sacsewer.com) or 916-876-6030.

Sincerely,



Terrie Mitchell  
Manager, Legislative and Regulatory Affairs

ATT 1: SRCSD Specific Comments on the Fifth Draft of the Delta Plan by Chapter, Page & Line Number

ATT 2: “A Review of Delta Fish Population Losses from Pumping Operations in the Sacramento-San Joaquin River Delta”, Larry Walker and Associates, January 2010.

cc: Stan Dean, District Engineer, SRCSD  
Prabhakar Somavarapu, Director of Policy & Planning, SRCSD  
Linda Dorn, Environmental Program Manager, SRCSD  
Tom Howard, State Water Resources Control Board Executive Officer  
Pamela Creedon, CVRWQCB Executive Officer  
Cliff Dahm, Delta Science Program  
Richard Norgard, Chair Delta Independent Science Board  
Mike Healy, Co-Chair, Delta Independent Science Board

In general, the Delta Plan fails to acknowledge the impact of the ecosystem crisis in the Delta on Delta communities. As a result of a failed Delta, which may have had no relationship to wastewater and urban runoff discharges, the Delta Plan calls for tighter regulation, reduced loadings of “contaminants,” “stressor fees,” etc. To the extent the ecosystem problems in the Delta are due to water project operations, it is only equitable that the Delta Plan would be equally aggressive in setting stressor fees, immediate actions, goals, and performance measures to reduce water project impacts as well.

## **Preface**

Page 5, line 29 – the Plan refers to “the ecosystem’s safe yield” in discussing water supply reliability. The Plan fails to acknowledge or postulate that the safe yield of the Delta has been exceeded in terms of Delta exports. The Plan also fails to state directly that the original expectations of the State and federal projects, which were designed over 50 years ago without serious consideration of the effects of the projects on the Delta environment (Preface, page 3, line 13), have little or no connection to the concept of “safe yield.”

The State Water Resources Control Board (SWRCB) flow criteria published in August 2010 indicate that export volumes should be reduced, i.e. that current volumes have exceeded the safe yield. Federal biological opinions also support this indication by requiring limitations on export operations to protect endangered fish species. The Plan should be modified to include statements acknowledging that the safe yield of the Delta has been exceeded.

Page 8, line 17 – The Plan seeks to “promote programs that reduce contaminant loads to the Delta.” This simplistic strategy needs to be reexamined. Load reduction needs must be assessed in terms of water quality impact and beneficial use protection. Load reduction for reduction’s sake, without such linkages to beneficial use protections is inequitable and inefficient.

Page 9, line 29 – The Plan states that “we cannot afford [to] wait for “the perfect solution” to every problem.” This is particularly true with regard to exports and entrainment, where our knowledge of direct impacts is far greater than it is for other stressors. For a number of those other stressors, the Plan is encouraging immediate actions, goals and performance measures. A similar approach should be taken for exports and entrainment. Specific performance measures pertaining to the reduction of entrainment effects in the short term should be included in Chapter 5, pages 125 through 128.

## **Chapter 1 The Delta Plan**

Chapter 1 of the Plan fails to address the past and present role of exports on the deterioration of the Delta ecosystem. In general, the Plan exhibits an uneven lack of emphasis regarding the role of exports as a stressor in the Delta, in comparison to other stressors. The Plan fails to include the following facts that pertain to the role of exports in the Delta water picture:

- A time series chart of Delta exports and fish losses since the SWP and CVP were placed in operation;
- Information on the impact of exports on entrainment, i.e. a summary of specific information contained in the August 2010 SWRCB Delta Flow Criteria document;
- Available information regarding the impacts of entrainment on fish – mortality numbers, possible population effects, indirect effects. ( It is observed that if similar mortality numbers

to those that have been documented as entrainment losses were ascribed to episodic pollution events, the plan would not neglect such information and would have extensive commentary regarding ongoing “fish kills”); and

- Available information from the federal biological opinions.

In contrast to most other stressors, the Fifth Draft includes no stated goals or performance measures for the reduced loss of fish through entrainment or for specific activities that would reduce these losses. For the Council’s information we are including a white paper on entrainment prepared by Larry Walker Associates, January 2010, titled “A Review of Delta Fish Population Losses from Pumping Operations in the Sacramento-San Joaquin River Delta.”

Page 22, Table 1-1 –The SWRCB is the state entity responsible for implementing the Clean Water Act for the State of California on behalf of the United States Environmental Protection Agency, and should be mentioned in the table. The hundreds of local reclamation districts, water districts, and city and county governments should be included in an appendix that describes each agency’s roles and responsibilities in the Delta.

Page 26, lines 42-44 – When Figure 1-3 is developed the target outcomes for the Delta Plan should be linked to performance measures to determine if the target is being achieved.

## **Chapter 2 Science and Adaptive Management for a Changing Delta**

Page 45, line 14 – It is stated that the most desirable sources of scientific information are those that are contained in peer reviewed publications including scientific journal publications and books. The Plan should also state that the critiques of such publications also represent a most desired source of scientific information, so long as the critiques are also published in peer-reviewed journals.

## **Chapter 3 Governance: Implementation of the Delta Plan**

Page 57, lines 30-35 – The Fifth Draft cites the definition for “covered action” from the Delta Reform Act on page 43. It then reviews the application of the four criteria that must be met in order for an action to be a covered action. However, with respect to one part of the test established by the Legislature, the Fifth Draft states that the “Council has determined” the meaning of a “significant impact”. In essence, the Council’s interpretation would be that the statutory term “significant impact” means “substantial change in existing conditions” and that the term incorporates direct and indirect, and cumulative effect, considerations.

We believe it is unnecessary and imprudent to “determine” the meaning of the statute through the Fifth Draft. Also, the proposed determination itself creates need for interpretation, and is not consistent with the statute. Accordingly, SRCSD recommends:

In addition, a proposed plan, program, or project must have a “significant impact” ~~under Water Code section 85057.5(a)(4). For this purpose, the Council has determined that~~ “significant impact” means a substantial change in existing conditions that is directly, indirectly, and/or cumulatively caused by a project and that will affect on the achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and State interests in the Delta, **as provided in Water Code section 85057.5(a)(4).**

Page 57, lines 36-38 – Projects required through a regulatory action should be exempted from consistency determinations, such as the issuance of an NPDES permit by a Regional Water Quality Control Board. We recommend adding the issuance of an NPDES permit, and any related activities required as part of that State/Federal permit, as well as the California Endangered Species Act take permit example.

Page 60, lines 26-28 – Short form certifications of consistency when an action is taken in conformance with another plan that has been incorporated into the Delta Plan does not appear to be detailed following Governance Policy 1 (GP 1). If the “Discretionary Incorporation of Specific Projects into the Delta Plan” on page 62 is what the short form certifications is referring to, then that should be made clear.

Pages 60-61, lines 30-43 and 1-9 – GP 1 includes terms that should be deleted. First, it states, “A covered action must be consistent with the coequal goals and inherent objectives.” We interpret this statement to mean that, notwithstanding the adoption of a Delta Plan after a long process, the Council would reserve the ability to determine whether every single covered action meets the highly subjective test of “consistent with the coequal goals and inherent objectives.” This would be an extraordinary usurpation of local power. It also calls into question the Council’s confidence in the quality of the remainder of the Draft Plan. A vague catch-all is not needed or appropriate.

GP 1 also outlines a term that would subject local agencies to attacks that are unreasonable. In particular, GP 1 states that covered actions must disclose potentially significant adverse environmental impacts and feasible mitigation of those adverse impacts. This appears to restate what CEQA already requires. GP 1 would not, however, be benign. An opponent of the covered action would be afforded a new tool: in addition to the right to allege non-compliance with CEQA through a court action, the opponent could allege non-compliance with CEQA through appeal of a consistency determination. The provision thus would both create a “second bite of the apple” to challenge local agencies, and authorize surprise attacks on the adequacy of environmental review, after local agencies’ completion of CEQA documents. We recommend the following language change to avoid redundant CEQA challenges:

All covered actions must be fully transparent by disclosing all potentially significant adverse environmental impacts and mitigations of those adverse impacts. **This requirement is satisfied if the proponent of the covered action or a lead agency prepares an environmental impact report or initial study under CEQA.**

GP 1 also states that covered action proponents shall certify that the covered action shall comply at all times with applicable law. While the provision seems harmless, what will it actually accomplish? Perhaps proponents can certify that they will be perfect, but it is difficult to believe this provision would accomplish much. In the real world, 100 percent compliance with all federal and state and local laws, 100 percent of the time, may be difficult for some projects. We recommend also that the Council evaluate whether local agencies have the authority to require such certifications; for example, can a land use agency require a project proponent to certify that it will comply with federal tax laws? We encourage the Council to consider what will actually be gained by this provision.

## **Chapter 5 Restore the Delta Ecosystem**

Page 124, lines 25-34 – ER R7 recommends the Delta Science Program, Department of Fish and Game, Department of Water Resources, State Water Resources Control Board and other relevant agencies and stakeholders should conduct workshops to develop recommendations to the Council for measures to reduce stressor impacts. SRCSD would like to be an active participant in these workshops and helping with the organization of such workshops. The State Agencies may need some assistance from stakeholders considering the short turnaround time for this recommendation; it is to be completed by January 1, 2013.

## **Chapter 6 Improve Water Quality to Protect Human Health and the Environment**

Thank you for making many of the recommended changes we requested to the Water Quality chapter of the Fourth Draft. The majority of our requests on the Fifth Draft are related to drinking water quality to clarify misleading statements.

Page 133, line 9 – Drinking water supply is regulated by the California Department of Public Health, with oversight by USEPA (the same as the Regional Water Boards regulating water quality).

Page 133, line 26 – The following language change should be made to reflect regulation of water quality under the Clean Water Act. Deletions are shown in strikethrough, and additions are shown in bold and underscore.

*Discharge of treated wastewater, urban runoff, or agricultural return flows should be regulated so that they do not ~~significantly affect the Delta~~ **impact beneficial uses.***

Page 134, lines 20-24 – This sentence should distinguish between water quality objectives established by the Regional Water Boards Sacramento-San Joaquin Rivers Basin Plan and San Francisco Bay Regional Water Board, and the State Water Resources Control Board Sacramento-San Joaquin Delta Estuary Water Quality Control Plan. The Regional Boards do not implement water quality objectives established in their basin plans by “...assigning responsibilities to water right holders and water users.”

Page 134, line 34 – NPDES permits are required to be renewed and modified every 5 years as required under the Clean Water Act. We recommend the following language changes with deletions in strikethrough and additions bolded and underlined.

*These permits are ~~reviewed~~ **renewed** and modified, ~~if necessary~~, at 5-year intervals.*

It should also be noted that the Regional Water Boards can re-open an NPDES permit at anytime.

Page 135, Table 6-1– Another column should be added to identify whether the TMDL is approved or under development.

Page 136, line 19 – Where the reduction of loads is required by SWRCB and RWQCB, it is done for a specific purpose, for specific constituents, and not as a general requirement.

Page 138, line 13 – Will the water quality standards for salinity in the South Delta be achieved after implementation of the BDCP, where higher salinity water from the San Joaquin will tend to dominate the resulting regime in the South Delta?

Page 138, Lines 35-36 – The statement is incorrect, per Wim Kimmerer and Anke Mueller-Solger “Where does the River Meet the Sea? Connections and Boundaries in the San Francisco Estuary” (2011) State of the San Francisco Estuary Conference. Dr. Kimmerer presented that fish migrate with the salt/fresh water interface and remain in the water with the optimum salinity level for each fish species. Fish are unaffected by migration of the salt/fresh water interface. Benthic organisms, on the other hand, cannot migrate with the moving interface and have adapted to its movement.

Page 139, line 30 – The statement that “pathogenic protozoa, bacteria and viruses are...a disease risk for both drinking water and body-contact recreation” in Delta waters is unsubstantiated and not consistent with available data gathered by the Central Valley Drinking Water Policy work group (Drinking Water Policy work group). Please either modify this statement or cite the source for this statement.

Page 139, lines 32-35 – The statement is misleading because the water treatment plants that use Delta water have been designed to ensure that harmful levels of trihalomethanes are not present in tap water, in accordance with Safe Drinking Water Act requirements. Additionally, costs to treat Delta water to meet current SDWA requirements are not increasing, since TOC levels in Delta waters are trending downward. Recent reports available on the Central Valley RWQCB website under ([http://www.swrcb.ca.gov/rwqcb5/water\\_issues/drinking\\_water\\_policy/](http://www.swrcb.ca.gov/rwqcb5/water_issues/drinking_water_policy/)) prepared by West Yost Associates and Malcolm Pirnie should be reviewed to obtain the current understanding of this issue.

Page 140, line 8 – The implication that water is “unpalatable” at 500 mg/l TDS is misleading. The California Secondary MCL Consumer Acceptance Contaminant Levels for TDS range from 500 mg/l (recommended) to 1000 mg/l (as an upper average value) and 1500 mg/l (as a short term value). The basis for the secondary MCL for TDS is aesthetics – color, taste, staining. There is no human health risk associated with the TDS secondary MCL values.

Page 140, line 18 – Available *Cryptosporidium* data for the Delta collected by the State Water Project and other water agencies under the Information Collection Rule indicates that regulatory thresholds are neither exceeded nor threatened to be exceeded. The statement that these protozoa are present and therefore pose a risk implies that the risk is significant and/or unacceptable i.e. exceeds the one in ten thousand risk level for tap water as allowed under the SDWA. Such is not the case from either a drinking water or body contact recreation standpoint. Therefore, the following edits are suggested:

Source waters that exceed drinking water regulatory thresholds for *Cryptosporidium* trigger additional pathogen removal requirements (USEPA 2004), **although available data do not demonstrate that such conditions currently exist in the Delta.**

Page 140, lines 23-28 – Information is not available through the Drinking Water Policy work group or elsewhere that indicates that ambient levels of nutrients can be managed to attain levels that would prevent taste and odor episodes in the Delta or in downstream reservoirs.

We recommend the following changes:



~~Taste and odor complaints associated with Delta water supplies have been attributed to algae growth in reservoirs or in the Delta itself (DWR 2007).~~ **primarily to films of benthic cyanobacteria that grow on the sides of the reservoirs and on the dams (Izaguirre & Taylor 2007). So far, it has not been possible to predict taste and odor events in the SWP on the basis of nutrient loads from in-Delta sources or in-channel nutrient concentrations. Because of the characteristics of taste and odor sources, a potential conclusion is that the control of nutrients should not be for the purpose of controlling taste and odors (Lee 2008). Management of this issue through nutrient controls has not been established to be warranted or effective.**

Page 140, lines 37-38 – Studies prepared for the Drinking Water Policy work group indicate that population growth in the Delta watershed will not pose a future threat to drinking water quality, since reductions resulting from current Clean Water Act and California Water Code regulations and NPDES permit requirements will more than offset the incremental increases in loads associated with population growth.

The following edits are suggested:

A major concern for municipalities using Delta water is what the future holds for water quality **in relationship to** sea level rise, levee failure, **and** salinity variability., ~~and~~ **Although available information indicates that** population growth in the watershed does not pose[s] a threat to drinking water quality. The Central Valley RWQCB is developing a drinking water policy that **will** ~~is, in part, intended to~~ **address the need for additional regulatory requirements to protect** ~~prevent degradation of~~ high quality drinking water sources...

Page 141, Line 28-30 – The statement that emerging contaminants affect Delta species and ecosystem processes is unsupported. At this point it is speculation. Also listed is “other substances in the food web,” which makes no sense.

Page 142, Line 5 – Dugdale’s ammonium concentration units should be micromolar, not micrometer.

Page 143, Line 16 – The Figure 6-2 caption that reads “Increasing nutrients create Delta water problems” is inappropriate. It conflicts with the narrative conclusions that state further study is required to determine nutrient effects on the Delta. Also, the information provided in the figure does not make the case that nutrient levels in the Delta have created “Delta Water Problems”. While nutrient levels in the Delta have been identified as a concern and topic for Delta research, key questions remain unresolved, as noted on page 144, lines 1 through 6.

Page 148, Lines 28-31 and page 150, Line 7– The recommendation for nutrient objectives to be developed and adopted for the Delta by 2014 is inconsistent with the narrative conclusion on nutrients (pages 142-143) which states that further study is required to determine nutrient effects on the Delta.

Page 144, lines 35-36 – While pyrethroids have been detected at levels of concern in some undiluted wastewater treatment plant effluents, testing of waters immediately downstream of those discharges has not revealed ambient levels that exceed toxicity thresholds.

Page 148, lines 28-38 – Recommendation WQ R6 sets a January 1, 2014 target date for development and adoption of nutrient objectives in the Delta, and a January 1, 2016 completion date for implementation of a Delta pyrethroid TMDL. Setting such deadlines for the adoption of nutrient

water quality objectives and a pyrethroid TMDL is unreasonable, and is highly problematic because the scientific basis for conclusions therein may not be fully developed by the specified dates. Additionally, the January 2014 date for development and adoption of nutrient objectives seems to not consider the existing processes by the San Francisco Bay Regional Water Board for developing numeric nutrient endpoints (NNEs), nor the State Water Boards process for developing NNEs. Completing the Central Valley Pesticide TMDL and Basin Plan Amendment for pyrethroids by the beginning of 2016 is also unrealistic considering the lack of information currently available and the fact that the Central Valley Regional Water Board is behind schedule.

Page 149, lines 10-14 (Recommendation WQ R8) – This recommendation should pertain to specific contaminants and water bodies (e.g. those identified on the 303(d) list) rather than as a generalized statement applicable to all “contaminants.”

Furthermore, the recommendation appears to provide a general call for reduced loadings from Central Valley municipalities, which goes beyond established regulatory policies and requirements. This recommendation suggests that the Central Valley Regional Board should require certain types of treatment merely because such treatment may be feasible, though not necessarily required. It is important to reiterate to the Council that pursuant to Water Code section 13360(a), the Central Valley Regional Board may not dictate the manner of compliance. The Central Valley Regional Board is required to set effluent limitations for POTWs designed to protect beneficial uses and ensure compliance with water quality standards; however, it is then left to the discretion of POTWs how they will comply with those effluent limitations. This recommendation proposes a direct contradiction to applicable water quality laws and should be removed.

Page 149, lines 15-17 (Recommendation WQ R9) – The recommendation in this section should be modified to reflect a planning and evaluation step ahead of the initiation of special studies. The purpose for each study, hypotheses to be tested, pollutants to be examined, and other factors should all be considered prior to the decision to implement a given study.

We request the following changes:

WQ R9     The State Water Resources Control Board and Regional Water Quality Control Boards should **consider** ~~conducting or require~~ special studies of pollutants including **selected** emerging contaminants and causes of toxicity in Delta waters and sediments ~~by January 2014~~.

Moreover, the Fifth Draft’s discussion of “emerging contaminants” seems to suggest that preemptive regulatory measures should be taken for such pollutants before their levels of concern and associated environmental effects are fully understood. The addition of the 2014 implementation date for conducting these special studies of emerging contaminants is premature, in part because special studies cannot be conducted until an appropriate test methodology is established for such contaminants. Thus, the deadline in the Fifth Draft is unrealistic and fails to account for the necessary prerequisites to completing the relevant studies.

Page 150, line 7 – While we support efforts to evaluate the need for nutrient objectives in the Delta, we do not agree with the assertion that objectives are needed or that the time frame for completion of this highly complicated task (in two and one half years) is appropriate or realistic. The State Water Board process for consideration of nutrient numeric endpoints (NNEs) in San Francisco Bay is just starting and is not connected to any similar effort in the Delta. The development and use of mathematical models is an essential aspect of the NNE effort. The time frame for consideration of

nutrient objectives in the Delta must be aligned with the San Francisco Bay NNE effort. Also, on a technical level, the need exists for very close coordination and/or direct linkage between the Delta and San Francisco Bay efforts. We request the following changes to this performance measure.

SWRCB and RWQCBs **consider** adoption of objectives for nutrients in the Delta **in conjunction with the SWRCB NNE effort for San Francisco Bay.**

Page 150, lines 20 and 21– The “Driver Performance Measures” discussion provides for an ultimate compliance date of 2020 for meeting TMDLs for “critical pesticides” (diazinon, chlorpyrifos, and pyrethroids) in the Delta. This could be problematic because the Central Valley Regional Board Pesticide TMDL is currently being developed, and is actually behind schedule. Thus, it is not appropriate for the Fifth Draft to set a specific compliance date when the underlying TMDL adoption is still many years away. That compliance date should be specified in the TMDL itself, not as part of the Fifth Draft. The deadline for a pyrethroid TMDL for the Delta by 2016 is also unrealistic. Currently, there are no existing water quality standards for pyrethroids, and before a TMDL can be established, water quality standards must be adopted into the relevant Basin Plans and approved by United States Environmental Protection Agency. This process alone takes considerable time, and would most likely extend well beyond the specified 2016 timeframe.

Page 150, lines 20 and 21– Reducing concentrations of phosphate is included in a list of inorganic nutrients recommended as driver performance measures. The reduction of concentrations of phosphates has not been required in NPDES permits or TMDLs in the Delta. An expectation of such reductions is unwarranted at this time. No support is provided for including phosphate. Phosphate has been cited as declining in concentration in wastewater effluent and in the Delta since the 1990’s when continuing efforts began to remove it from detergents. Even Glibert (2011) cites reduced phosphates in the Delta contributing to a N:P nutrient imbalance.

With regard to the presumption that reduced concentrations of all inorganic nutrients should occur, this prejudices the outcomes of the process to evaluate the need for nutrient objectives. At this point in time, as reflected in the text of the Delta Plan itself, there is significant controversy and lack of consensus regarding the need for or benefit of nutrient reductions in the Delta. The notion that progress should be shown toward ambient nutrient level reductions is clearly premature. Therefore, the following edits are requested:

Progress toward reducing concentrations of inorganic nutrients (ammonium, nitrate and phosphate) in Delta waters ~~over the next decade~~ **if deemed necessary as a result of the combined San Francisco Bay and Delta NNE effort.**

Page 150, lines 22-23 – This performance measure is inappropriate and should be changed as shown below. The notion that annual surveys of an unknown list of emerging pollutants should be required is a premature conclusion based on available information. This determination should only be made after completion of a process to evaluate the specific pollutants to be monitored, the reason for the monitoring, and the effects thresholds to be used in evaluation of collected data, at a minimum.

We recommend the following change:

~~Routine annual surveys of emerging pollutants within the Delta are designed and implemented during the first 5 years of adoption of the Delta Plan.~~ Regulatory agencies should **perform appropriate planning level activities to prioritize a specific list of pollutants of highest concern and to develop work plans for appropriate special studies**

**or monitoring efforts for those pollutants, and then conduct monitoring and special studies in accordance with the work plans.**

Again, this is for a class of pollutants which suffer from a lack of knowledge regarding environmental effects and for which neither water quality criteria nor water quality objectives exist.

Page 150, line 26 –The expectation that tissue levels of mercury in top predatory fish will decline over the next decade is probably overly optimistic, since the Delta mercury TMDL has not yet been approved by USEPA and Phase 1 of that TMDL (which will take almost eight years) will not implement final load reduction requirements.

Page 150, lines 28 and 29 – The occurrence of spring diatom blooms in Suisun Bay is largely controlled by benthic grazing by invasive clams, which is currently unmanaged. Reductions in ammonium in wastewater discharges required under NPDES permits will not occur for almost a decade and may not have an appreciable impact on the occurrence of blooms.

**Chapter 9 Finance Plan Framework to Support Coequal Goals**

We believe the current Finance Plan chapter has not changed significantly from the Fourth Draft. Therefore our comments on the Fourth Draft Finance chapter still apply.

Page 206, lines 31-33 – The Finance Plan should include the following four overarching principles:

- Delta programs and funding sources must be clearly delineated;
- Any assignment of costs must be equitable and based on a clear nexus between the paying entity and the program expenditure;
- There should be no double jeopardy – entities should not pay twice, and
- The financing plan must incentivize useful actions.

*Delta programs and funding sources must be clearly delineated*

An effective Delta Plan must include clear delineation of major programmatic funding needs, a broad and inclusive analysis of potential funding sources, and consideration of a comprehensive array of financing mechanisms. The four major Delta program areas that will require funding include administration of Delta Programs (the Delta Stewardship Council, the Delta Science program, the Delta Conservancy, and Delta Protection Commission); water supply reliability and alternative conveyance facilities; ecosystem restoration projects, and other Delta infrastructure and Delta as a place related projects.

In addition, the selection of actions needed to support Delta goals must be based on sound business perspectives to prioritize where money will be spent. Then once programs and projects are identified and prioritized, a broad view of potential financing mechanisms can be explored that include Federal and state general funds, State bond funds, public goods charges, and fees. However, to accomplish this enormous task, the finance plan should be phased and follow an adaptive management approach. The first phase should focus immediately on meeting short term needs, while the second phase should refine the variety of long term funding options available as the specific projects and costs become clearer.

*Any assignment of costs must be equitable and based on a clear nexus between the paying entity and the program expenditure*

In developing any “beneficiary pays” and “stressor pays” financing approaches, a broad view of beneficiaries and stressors must be taken. All significant beneficiaries and stressors must be considered regardless of whether they have a known source of funding behind them, and it is essential to make a rational determination of the relative proportion of benefits and stresses. In addition, not only does the state and federal governments bear a responsibility for financing significant portions of Delta programs, but the proponents of alternative Delta conveyance and export projects should pay all costs associated with facility development, construction, and associated ecosystem mitigation. Difficulty in securing state or federal funding is not a reason to push costs onto other entities or local government. Clearly, state and federal governments are not the only ones experiencing financial hardships.

*There should be no double jeopardy - entities should not have to pay twice*

Any viable long-term financing plan must protect against duplication of effort and duplication of charges. Investments towards compliance with regulatory requirements, investments in ecosystem restoration, and investments that otherwise further the co-equal goals should be inventoried and accounted for. An entity that is required to mitigate or eliminate a stressor should not also be required to pay a fee associated with the same stressor. For instance, the Clean Water Act is effectively a stressor pays program. NPDES permittees effectively “pay” by complying with regulatory requirements that require investments in capital and operational enhancements to mitigate their impacts, and as a result, beneficial uses of water are protected.

*The financing plan must incentivize useful actions*

Incentives should be provided that encourage organizations to invest in monitoring and research and to enhance projects to provide extra benefit to the Delta.

Page 206, lines 34-36 – Basing a stressor on volume of contaminants discharged should be changed to clarify that a stressor fee would be based on a load of a pollutant that is impacting beneficial uses. Dischargers are already paying permit fees that fund monitoring fees for the Surface Water Ambient Monitoring Program (SWAMP) in addition to other water quality monitoring that is required under permits. They should not be assessed another “stressor fee” based on the volume of contaminants discharged. Our discharges must be in compliance with State Water Code and Federal CWA provisions, permit requirements and be protective of beneficial uses. Therefore, to imply that additional fees should be imposed based only on the volume of contaminants is inappropriate. If stressor fees are included, it would be more appropriate that they be based on the degree to which the pollutant loading affects beneficial uses of the Delta.

Page 211, lines 19-30 (Recommendation FP R6) – The state should cover the start up costs without expecting reimbursement until a more permanent financing plan is established. The notion of fronting costs for the early years of the Delta plan is implausible, especially expecting repayment to the state from fees that do not currently exist, there is no legal authority to require, and no clear way of determining a way to structure a stressor fee. In passing the authorizing legislation governing development of the Delta Plan, the Legislature was aware that the state would incur some of the up-front costs of getting the Delta Plan established and did not explicitly provide for a retroactive fee mechanism such that no general fund monies would pay for the Delta Plan. Although fee revenue may ultimately be the mechanism for funding the ongoing efforts of the Council, the Conservancy and the Commission, it should not be the mechanism for retroactively funding activities that were necessary for the initial stages of establishing a framework for the Delta.

The Council would have far too much discretion in establishing the fee structure to be authorized by the Legislature. Specifically, the Fifth Draft states that “[t]he Legislature should grant the Council the authority to develop reasonable fees for beneficial uses, and reasonable fees for those who stress the Delta ecosystem. . .” There is no mention of a particular fee structure, nor is there any designation within the Fifth Draft of specific terms under which the Council could and should develop such a framework. Having the legislature give the Council the authority and the discretion to set stressor and beneficiary fees could be very problematic for even determining a method to establish such fees. It would be very difficult to separate the stressor from the benefiter when considering exports from the Delta. SRCSD is concerned that without providing at least some guidance in the Delta Plan on how the fees are to be assessed, the Council will be unconstrained in its ability to impose fees on local governments and other entities. Thus, we recommend that the Delta Plan include a more detailed outline of the fee authorization to be granted to the Council as part of this recommendation.

The Plan proposes recovering the \$50 million combined annual expenditures of the Council, Conservancy, and Commission through stressor fees and beneficiary fees (mostly from water dischargers and diverters), yet no contributions are sought from beneficiaries of flood control, ecosystem restoration etc. Would the Council consider fees imposed on all those that benefit and not just a select few? In previous versions of the Delta Plan, the Council listed other types of stressor fees, including land use charges, retail sales fees, habitat alteration fees, special diversion fees, recreation use fees, and hatchery fees, but too easily dismissed them as infeasible. The Fifth Draft proposes recovering the \$50 million combined annual expenditures of the Council, the Conservancy, and the Commission through stressor fees and beneficiary fees, yet no contributions are being recommended from beneficiaries of flood control, ecosystem restoration, and a long list of other beneficiaries and stressors. This seems highly selective and does not take into account all of the beneficiaries and stressors on the Delta. We recommend that the Council include a broader base of fee payers that more accurately reflects those that benefit from and contribute to stresses upon the Delta. Should the Delta Plan ultimately include “stressor” fees as a revenue raising mechanism, it must include all stressors to ensure that appropriate entities are paying their fair share.

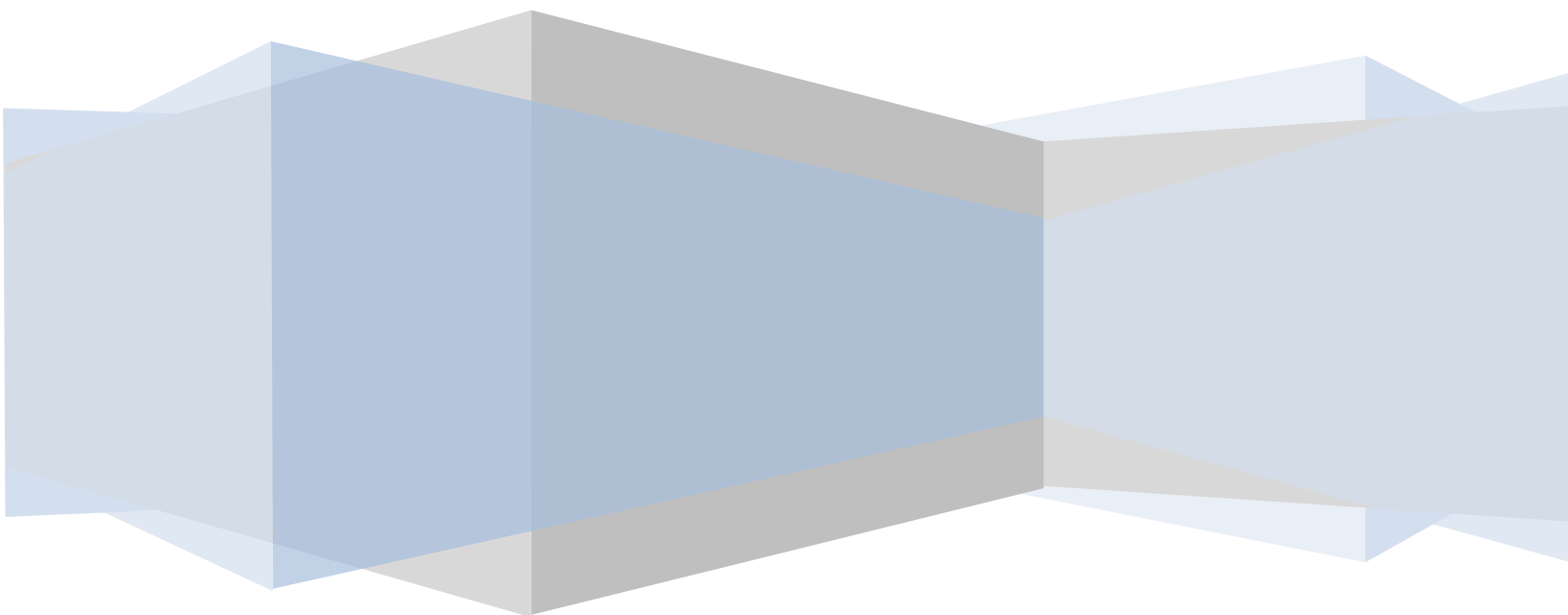
There should be an evaluation of existing fees that are paid by the various Delta users (exporters, dischargers, agriculture, recreational users, fisherman, etc.), and then determine if any restructuring needs to take place. There is the possibility that current fees could cover at least some initial costs of the Council.

SRCSD will be submitting a set of financing principles under separate letter for your consideration in response to the questions identified at the Council’s Finance.

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# **A Review of Delta Fish Population Losses from Pumping Operations in the Sacramento-San Joaquin River Delta**

*Prepared by Larry Walker Associates  
January 2010*



## Introduction - Overview of the Delta

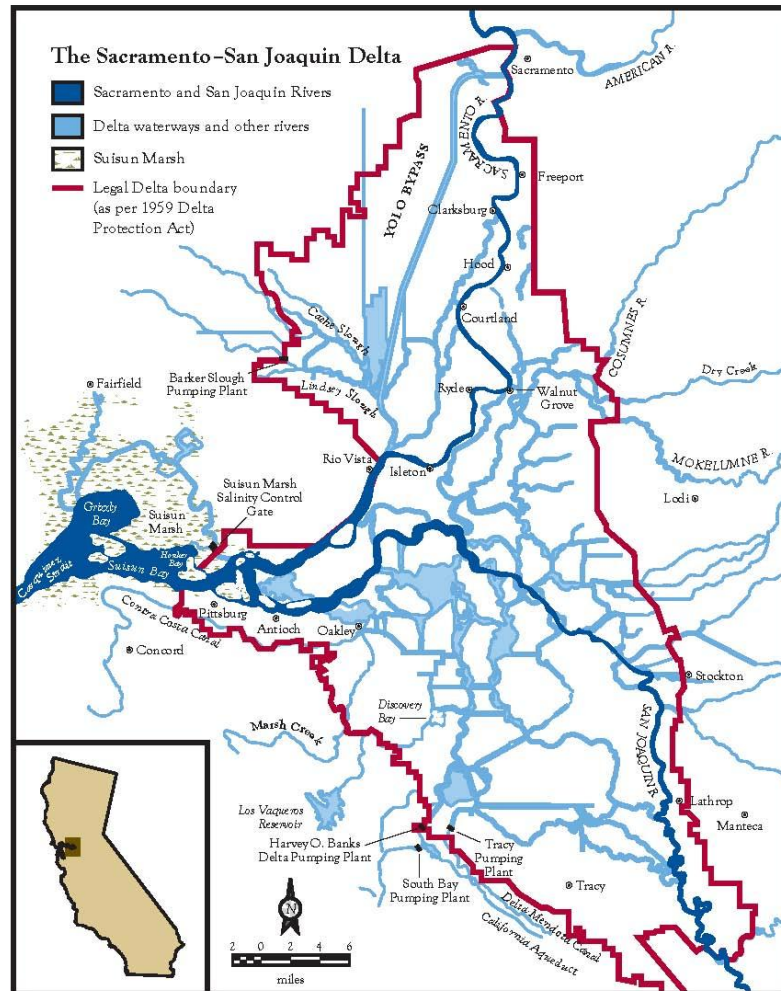
The Sacramento-San Joaquin River Delta is an inland river delta and estuary in northern California at the western edge of the Central Valley near the confluence of the Sacramento and San Joaquin rivers. It lies east of where the rivers enter Suisun Bay (an upper arm of San Francisco Bay).

Water flows from the Sacramento and San Joaquin Valleys to the Delta where it enters a maze of sloughs and waterways leading to the San Francisco Bay. The flow of water in the Delta is directed by an extensive system of levees. The flow patterns through the Delta are largely determined by:

- Tidal influences that move salt water in and out of the Delta daily;
- Flows from major rivers that vary considerably throughout the year;
- Operation of flow control structures on certain waterways in the Delta; and
- Export of water from the Delta for urban and agricultural use.

## Delta as Water Distribution System

The Delta serves as a major water distribution system for many parts of the State, and also many agricultural and



Map Source: PPIC Report - *Envisioning the Sacramento-San Joaquin Delta*.

municipal water diverters surrounding and within the Delta itself. The two largest water export systems are the Central Valley Project (CVP) and the State Water Project (SWP). Both systems take water from the southern part of the Delta and send it to other parts of the state, primarily the south.

The CVP is operated by the U.S. Bureau of Reclamation (USBR). It includes reservoirs upstream of the Delta, in-Delta facilities, and conveyance facilities that head towards the southern part of the state (for example, the Delta Mendota Canal). Within the south Delta, the CVP includes the Tracy Fish Collection Facility that helps to prevent fish



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from being pumped out of the Delta by the Jones Pumping Plant (formerly known as the Tracy Pumping Plant).

The SWP is operated by the California Department of Water Resources (DWR). It includes reservoirs upstream of the Delta, in-Delta facilities, and conveyance facilities that head towards the southern part of the state (i.e. the California Aqueduct). Within the south Delta, the SWP includes the intake



**Aqueduct of the State Water Project**

point known as Clifton Court Forebay, the Skinner Fish Protective Facility (a system designed to screen out fish from water pumped by the SWP so they can be transported back to the Delta), and the Banks Pumping Plant.

## **Fish Population Problems in the Delta**

The Delta is home to approximately 22 species of fish including the **delta smelt**, a key indicator species for the health of the Delta's ecosystem. In 2004 the delta smelt was found to be on the edge of extinction. Other fish experiencing serious population

declines include longfin smelt, salmon, steelhead and green sturgeon.

Numerous hypotheses related to water quality conditions and other stressors have been put forth as the cause or causes of the recent precipitous



**Delta smelt**

decline in threatened Delta fish populations. Few of these hypotheses focus on areas where a definitive link exists to fish mortality or impacts on fish populations. However, fish losses due to State Water Project and Central Valley Water Project pumping operations in the south Delta are well-documented, and have potential population level effects.

This document provides an overview of key reports that have documented fish losses due to pumping operations, and a chronology of efforts to identify and implement mitigation measures to prevent fish loss. The information indicates that while substantial fish losses have been documented since the late 1970s, comprehensive mitigation actions directed to reduce these losses have not occurred.

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*This document provides an overview of key reports that have documented fish losses due to pumping operations, and a chronology of efforts to identify and implement mitigation measures*

## Key Definitions

**Entrainment:** When fish are pulled into the vicinity and “trapped” in water project facilities. Entrainment occurs extensively in the Clifton Court Forebay when fish enter the forebay and cannot swim out.

**Pre-Screen Loss:** Losses of fish due to export operations that occur before they can be collected and salvaged at the fish protection facilities. Pre-screen losses can be particularly extensive in the Clifton Court Forebay due to predation from other fish and birds.

**Salvage:** Collection of fish upstream of pumping facilities with the intent of returning them safely to the Delta. The CVP’s Tracy Fish Collection Facility and the SWP’s Skinner Fish Protective Facility both use a series of louvers to direct fish away from the flow to the pumps and into holding tanks. From the holding tanks they are transported and released back into the Delta.

**Additional losses:** Some fish are not successfully diverted by the fish collection facilities and are pumped into the canals that head towards the south part of the State and are removed from the Delta population. Additional losses occur as a result of trauma during the salvage process. Fish are also killed by predators which congregate at locations where salvaged fish are released.

**Total Fish Loss:** Total of all fish losses associated with all components of water project operations. Includes pre-screen loss, loss during and after salvage, and loss at the pumps.

## Fish Salvage Operations

To reduce fish loss at the pumps, the state and federal water export facilities operate facilities which are designed to salvage fish from the water and return them to the Delta. Fish facilities include the SWP **Skinner Fish Protection Facility** and CVP **Tracy Fish Collection Facility**. The fish facilities utilize two sets of louvers to prevent fish from entering further into water project operations and ultimately the powerful pumps. The louvers concentrate fish so that they can be removed prior to the water diversions. However, these fish salvage operations are inefficient, as high numbers of fish are lost due to predation in the waterways leading to the fish facilities, and the louvers are inefficient (Gingras, 1997 and Bowen et al., 2004).

Fish caught at these facilities are placed in holding tanks, loaded into tank trucks, and pumped out of the trucks through pipes at two release sites each for the SWP and CVP. These are called “Collection, Handling, Trucking and Release Operations.”



The CVP's Tracy Fish Collection Facility



The SWP's Skinner Fish Protection Facility

**Clifton Court Forebay (CCF)** is a man-made regulating reservoir located in the Delta immediately upstream of the SWP intake. Inflow of water and entrained fish to CCF is controlled by three gates, which are opened at higher tide elevations to fill the reservoir. The forebay allows water project operators to control water depth and velocity at the fish facility and pumps. The forebay contains high numbers of predators (fish and birds), which contribute to “pre-screen” mortality.



Aerial view of Clifton Court Forebay

## Reports examining fish losses related to CVP and SWP pumping operations

Fish losses related to water project pumping operations have been documented in studies as far back as the 1970s. The following sections describe some of these key reports and studies that summarize fish losses.

### 1996 – DWR and DFG: Effectiveness of Fish Salvage Operations

A 1996 review by the Department of Water Resources and Department of Fish and Game (DFG) evaluated the effectiveness of fish salvage operations at the intake to the California Aqueduct between 1979 and 1993 (Brown et al., 1996). The authors evaluated fish salvage operations at the Skinner Fish Protection Facility, focusing on the fate of Chinook salmon throughout the salvage operations. **Based on an evaluation of previous studies examining pre-screen losses in Clifton Court Forebay, the review concluded that predation was responsible for a 75% pre-screen loss for Chinook salmon.** The 75% estimate was an average of the 1978, 1984, and 1985 pre-screen loss estimates, and was adopted in 1986 as part of a DFG and DWR mitigation agreement to offset direct losses of fish at the export facility.

The authors noted that additional fish are lost at the Skinner Fish Facility, as the louvers are not completely effective at blocking fish from entering the pumps. They cited a study by DFG and DWR from 1970-1971, which found that efficiency of the primary louvers ranged from 70-85%, and

*Based on an evaluation of previous studies examining pre-screen losses in Clifton Court Forebay, a 1996 DWR and DFG study concluded that predation was responsible for a 75% pre-screen loss for Chinook salmon.*



that efficiency of the secondary louvers ranged from 70-95%, and were more efficient for larger fish. The authors also noted that predation within the louvers could additionally cause an unknown portion of losses at the facilities.

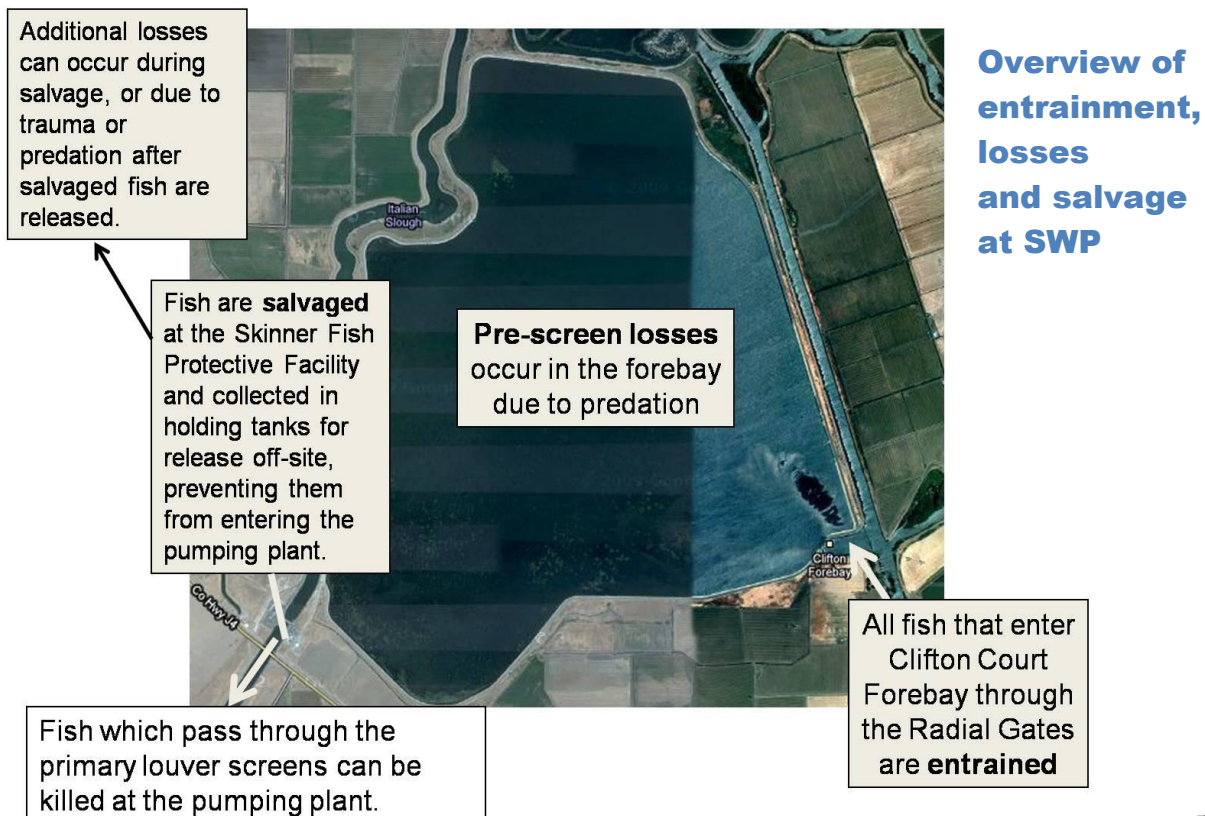
The report concluded that **for every salmon salvaged, more than three were lost to predators in the forebay or through the fish screens, and that these statistics “demonstrate a serious problem.”** Due to the magnitude of the problem, a number of efforts were suggested to mitigate fish losses. Efforts suggested were: replacing existing screens, reducing the number of salmon entering the forebay and encountering the screens, and moving the intake for the California aqueduct.

#### 2008 – USFWS: Biological Opinion

In the 2008 biological opinion for delta

smelt, United States Fish and Wildlife Service (USFWS) noted that fish entrainment at the Banks and Jones pumping plants is among the best-studied sources of fish mortality in the San Francisco estuary, due to the large volumes of water that are drawn from the estuary. All fish species inhabiting the Delta have been shown to be entrained in the export facilities.

Entrainment is of particular concern during dry years, when distributions of vulnerable fish populations shift upstream, closer to the export facilities. **The biological opinion pointed out the magnitude of entrainment at the export facilities, citing statistics that approximately 110 million fish were salvaged at the Skinner Fish Facility over a 15-year period.** The authors state that salvage statistics greatly underestimate the number of fish entrained, as they do not include losses through the louvers, nor do



they account for high rates of predation in Clifton Court Forebay. To emphasize the severity of the problem, USFWS states that **high entrainment during winter months was suspected as a contributing cause to the early 1980s delta smelt decline**, as well as the Pelagic Organism Decline (the detection of record low numbers of four fish species that occupy the open waters of the San Francisco Bay Estuary).

#### **2009 -- NMFS: Biological Opinion**

The 2009 Biological Opinion for Salmonids reported high pre-screen losses in Clifton Court Forebay. Two studies that estimated losses due to predation in the forebay found:

- Pre-screen loss ranging from 63-99% for juvenile Chinook salmon and 70-94% for juvenile striped bass (Gingras, 1997).
- Pre-screen loss of steelhead ranging from 78-82% (DWR, 2008).

**These studies indicate that mortality is very high in the forebay for Endangered Species Act-listed salmonids, with 75-80% lost due to predation.** The biological opinion stated that, based on the increased frequency of greater pumping rates anticipated for the SWP, NMFS anticipates that substantial numbers of additional Chinook salmon and steelhead will be lost due to predation in the forebay. If pumping increases, additional salmonids will be drawn into the forebay, particularly during the months when those species are most present in the system and therefore vulnerable to predation. NMFS drew the conclusion that: “The proposed near term and future operations of the SWP, through the operations of the Clifton Court Forebay, will exert additional adverse effects upon the listed salmonid populations. The loss of these additional individual fish will further reduce the populations of listed salmonids.”

#### ***The Plight of “Salvaged” Fish***

*Fish are impacted during the salvage operation due to trauma inflicted during the handling, trucking, and release operations when fish are transported from the collection facility to the release location in the Delta.*

*Typically, there is debris present in holding tanks along with the fish, which can injure and kill fish during transport. The biological opinion describes additional trauma to fish due to turbulent forces that occur when fish are pumped through the pipe which releases them into the river, and can injure and disorient fish; potential stranding of fish in the tanker truck if debris clogs the exit-way when water is emptied; vulnerability to predation when disoriented fish are released since predators are attracted to those release locations; delayed mortality from injuries; and shock from water quality conditions changing too quickly during the release procedure.*

*The biological opinion estimated that an additional 2% of fish die within 48 hours of release due to non-predation related stress. Release predation rates have not been quantified, but most likely add an additional 10 to 30% mortality.*

*- NMFS 2009 Biological Opinion*

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### 2009 – DWR: Quantification of Pre-Screen Loss of Juvenile Steelhead in Clifton Court Forebay

To follow up on a 2004 NMFS biological opinion, DWR conducted a series of studies to assess and quantify pre-screen losses of steelhead in Clifton Court Forebay, which was summarized in a 2009 report (DWR, 2009). The researchers completed smaller-scale studies in 2005 and 2006, and conducted a full-scale study in 2007. They tagged steelhead, released them at the entrance gates, and determined their fate by following the location of the tags. Pre-screen losses within Clifton Court Forebay ranged from 78-82%. Researchers focused on predation both by striped bass and by bird species, finding evidence that both predator types are foraging near the entrance gates.

The report recommended creating and implementing a management plan to reduce pre-screen losses within Clifton Court Forebay. It suggests revisiting predator reduction strategies which were studied during the 1990's, as well as conducting feasibility studies to determine if changes to the configuration of the forebay could reduce entrainment.

This report mentions that high losses in Clifton Court Forebay have been known about since the early 1980's. It refers to statistics on pre-screen losses from DFG studies conducted between 1976 and 1993, which show the range of pre-screen losses of juvenile Chinook salmon to be 63-99%.

### 2009 – USFWS: Ongoing Research on Delta Smelt Pre-Screen Loss and Salvage Efficiency

Ongoing research by Castillo with the USFWS has focused on estimating pre-screen loss and salvage efficiency for delta

smelt (Castillo, 2009). Research conducted from February through June 2009 used marked delta smelt to evaluate salvage facility efficiency at Skinner Fish Protection Facility and pre-screen loss in Clifton Court Forebay. Results were presented in a poster at the 2009 State of the San Francisco Estuary Conference, where the study was noted as the “first experimental evaluation of the relation between delta smelt salvage at the Skinner Fish Protection Facility and underlying entrainment losses at the SWP in the south Delta.”

Study results suggested that entrainment losses of delta smelt could be much higher compared to other species previously studied at the SWP, and that pre-screen losses were very high for delta smelt. The percent recovery of delta smelt released at the entry point of Clifton Court Forebay and then recaptured at Skinner Fish Facility was low: 2.98% in February, 0.42% in March, and 0.03% in June. **The vast majority of delta smelt mortality could be attributed to pre-screen losses, which were 94.2% in February, 99.0% in March, and 99.9% in June.**

### Summary of Data Related to Pre-Screen Losses

The following table summarizes pre-screen loss data dating back to 1976. A report by Gingras (1997) summarized pre-screen loss data from mark-capture experiments in Clifton Court Forebay by DFG. More recent data were presented by Castillo (2009) in the presentation described in the previous section. Pre-screen loss percentages range from 63% to 99% for juvenile Chinook salmon, and from 94% to 99.9% for delta smelt.

## Summary of Data related to Pre-Screen Losses

Year	Species	Pre-screen loss %	Study/Reference
1976	Juvenile Chinook salmon	97	Gingras, 1997
1978	Juvenile Chinook salmon	88	Gingras, 1997
1984	Juvenile Chinook salmon	63	Gingras, 1997
1985	Juvenile Chinook salmon	75	Gingras, 1997
1986	Striped bass	70	Gingras, 1997
1992	Juvenile Chinook salmon	99	Gingras, 1997
1993	Juvenile Chinook salmon	99	Gingras, 1997
2007	Juvenile steelhead	78-82	Clark et al., 2009
2009 - February	delta smelt	94.2	Castillo, 2009
2009 – March	delta smelt	99.0	Castillo, 2009
2009 – June	delta smelt	99.9	Castillo, 2009

### Linkage of fish loss findings to population level impacts

The absence of prior work to address the linkage between the ongoing fish mortality in and around the south Delta pumps and population level effects is striking.

An article prepared by Kimmerer (2008) for San Francisco Estuary & Watershed Science provides valuable analysis of the effect of the direct loss of salmon and delta smelt associated with fish screens and pumping operations on the populations of those species. Losses of fish to mortality associated with export pumping have been blamed in part for declines of numerous species including striped bass (Stevens et al. 1985), Chinook salmon (Kjelson and Brandes 1989), and delta smelt (Bennett 2005).

Prior reviews relied on correlation analysis to attempt to link the pumping operations to fish population declines. Yet despite strong correlation, no quantitative estimates have been made to determine the impact of fish losses at the water export facilities on the

entire population of fish species. Moreover, there have been no published reports to measure the export losses against subsequent population size. As Kimmerer, a prominent ecologist and Delta researcher points out, this assessment “requires an analysis of mechanisms rather than one based on correlative relationships alone.” Using a mechanistic rather than correlative approach, Kimmerer found the following:

- Based on management targets for the Delta, salmon losses are higher than expected. Levels of mortality at the export facilities may place constraints on the recovery rate of the listed winter- and spring-run stocks of salmon.



Chinook salmon, *Onchorhynchus tshawytscha*.  
Reclamation photo by Rene Reyes.



- For adult delta smelt, Kimmerer estimated that approximately 30 times more delta smelt are entrained than are salvaged, with an overall pre-salvage loss rate of 97%. The estimates for cumulative loss of delta smelt over one season ranged from 3% to 50% for years 2002-2006. When looking at data back to 1995, mean proportional losses ranged from 0 to 23%.
- The proportional loss rates for larval and juvenile delta smelt peaked in early April from 1997 to 2005. The proportional losses were related to export flow, with the lowest proportional losses (approximately 25%) occurring during the dry years 2001-2003, and with a proportional loss of 62% occurring when export flow was at a maximum.
- Manipulating export flow (and, to some extent, inflow) is the only means to influence the abundance of delta smelt that is both feasible and supported by the current body of evidence.
- Losses of fish due to altered hydrodynamic conditions or migration cues in the Delta are called “indirect” losses. Although export pumping has substantial impacts on flow patterns in the Delta, the extent to which such alterations affect survival of fish is much less clear. Indirect losses may be important (NMFS, 2004), but they remain hypothetical and unquantified.

Kimmerer speculated as to the population level consequences of these proportional losses, comparing them to losses from other sources of mortality. When compared to fishing mortality, Kimmerer concluded that “the calculated loss rate at the export facilities would be a significant component

of direct anthropogenic mortality” for Chinook salmon.

The above findings are consistent with those used in the 2008 and 2009 biological opinions on delta smelt and Chinook salmon prepared by federal fisheries experts at US Fish and Wildlife Service and the NOAA National Marine Fisheries Service, respectively, which were summarized previously. The USFWS biological opinion noted, “Increased pumping at the Banks and Jones export facilities corresponds to the decline of the delta smelt population during the period both prior to and following its listing under the Act” (USFWS, 2008 p. 276), and the NMFS biological opinion states that “[T]he long-term operations of the CVP and SWP are likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Southern DPS (distinct population segment) of North American green sturgeon, and Southern Resident killer whales” (NMFS, 2009 p. 575).

## **Remedial actions/projects that have been considered/taken by project operators**

Actions aimed to prevent losses of fish at project facilities include the following types of projects, which are described in the following sections:

- Gates and physical barriers;
- Screens and ladders at Delta diversion points;



- Non-physical barriers;
- Pre-screen loss mitigation efforts in Clifton Court Forebay; and
- Efforts to reduce mortality during salvage operations.

## Gates and Barriers

### *Head of Old River Barrier and the Vernalis Adaptive Management Program*

The South Delta Temporary Barriers Project, initiated as a test project in 1991 and extended for five years in 1996 and again for seven years in 2001, occurred partially in response to a 1982 lawsuit filed by the South Delta Water Agency. The project consists of four rock barriers across south Delta channels which are installed and removed every year, except when prevented by high San Joaquin River flows.

The Barriers Project includes the Head of Old River Barrier (HORB), at the confluence of Old River and the San Joaquin River, which is in place most years since 1963 for 6 weeks in the Fall (September 15-November 30), and was in place for 6 weeks in the Spring (April 15-May 30) in 1992, 1994, 1996, 1997, 2000, 2001, 2002, 2003, and 2004, and 2007. Its purposes related to fish management are:

1. To prevent out-migrating salmon smolts in the San Joaquin River from entering Old River and getting drawn into south Delta export facilities; and
2. To increase attraction flows for upstream migrants by maintaining more of the San Joaquin River outflow within its natural channel.

The remaining three barriers are designed to increase water depths and improve quality



Head of Old River Barrier

for in-Delta agriculture and are installed between April 15-September 30 of each season. The Old River near Tracy barrier (ORT) has been installed since 1991 and the Middle River barrier (MR) has been installed since 1987. A rock barrier in Grant Line Canal (GLC) was first installed in spring 1996, and has since been installed in 1997, 1999, and 2000 through the present. The four rock barriers were not installed in 1998 due to high San Joaquin River flows.

The Vernalis Adaptive Management Plan (VAMP) was officially initiated in 2000 as part of State Water Resources Control Board (SWRCB) Water Right Decision 1641 (D1641), and is a 12-year experimental management program partially designed to determine what impact the HORB has on salmon smolt out-migration success. The plan provides a pulse flow in the San Joaquin River for a 31-day period at Vernalis during April and May and other flows identified by the Central Valley Project Improvement Act water acquisition plan, such as fall attraction flows.

The SWRCB Strategic Workplan for activities in the Delta calls for the review and potential amendment of southern Delta salinity and San Joaquin River flow objectives. The SWRCB requested in 2008 that the San Joaquin River Group Authority

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(SJRGAs) conduct a peer review of the VAMP to determine whether changes may be needed to the study to obtain necessary data points and to ensure the protection of San Joaquin River and Delta species. In 2009, the SWRCB conducted several workshops concerning potential amendments to San Joaquin River Flow objectives.

In 2008, a court order designed to protect delta smelt prohibited the installation of the spring HORB pending fishery agency actions or further order of the court.

### ***South Delta Improvement Program and NMFS Prohibition***

The South Delta Branch of the Bay-Delta Office of DWR<sup>1</sup> implements projects and actions in the south Delta as part of the CALFED California Bay Delta Authority Conveyance Program. The South Delta Improvement Program (SDIP)<sup>2</sup> was one of the key plans developed by the South Delta branch to implement several elements of the Preferred Alternative outlined in the CALFED Record of Decision (ROD). Stage 1 of the SDIP proposed four actions: (1) replacement of four seasonal rock gates currently installed in the Temporary Barriers Project (a fish barrier at Head of Old River, and three agricultural water control barriers at Old River at Tracy, Middle River, and Grant Line Canal) with permanent operable gates, (2) limited dredging in Middle and Old Rivers and West Canal, (3) extension of 24 existing local agricultural diversions in the south Delta to deeper water, and (4) an increase in the maximum SWP diversion to

8,500 cfs. Although one goal of the gate operations would be to reduce the movement of San Joaquin River fall/late fall-run juvenile Chinook salmon into the south Delta at the Head of Old River, a principal goal is to maintain water levels and water quality for agricultural diversions downstream of the head of Old River. All four proposed gates would be owned, operated, and maintained by DWR.

The SDIP was one of the elements of the SWP/CVP Operations Criteria and Plan (OCAP) analyzed by NMFS in its 2009 biological opinion. NMFS concluded that (1) the design, placement, and operation of permanent gates would create new habitat for predators and increase the proportion of winter-run Chinook salmon that encounter gates from 3% to 100%, (2) fish would have to negotiate an increased number of gates to move through the south Delta compared to the current Temporary Barriers Project, and (3) particle entrainment levels were too high, and the zone of entrainment too large, despite the planned operations of new gates. As a result, NMFS prohibited implementation of the SDIP as Action IV.6 in the Reasonable and Prudent Alternatives (RPAs) of the 2009 biological opinion.

### ***2-Gates Fish Protection Demonstration Project***

The RPAs in the USFWS (2008) and NMFS (2009) biological opinions for the SWP and CVP include actions to limit reverse flows in Old and Middle Rivers to reduce entrainment of fish at the export facilities. The 2-Gates Fish Protection Demonstration Project was designed by consultants of Metropolitan Water District of Southern California (MWD) and has been proposed as a 5-year adaptive management experiment to justify higher minimum export volumes than outlined in the USFWS and NMFS

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<sup>1</sup> <http://baydeltaoffice.water.ca.gov/sdb/>.

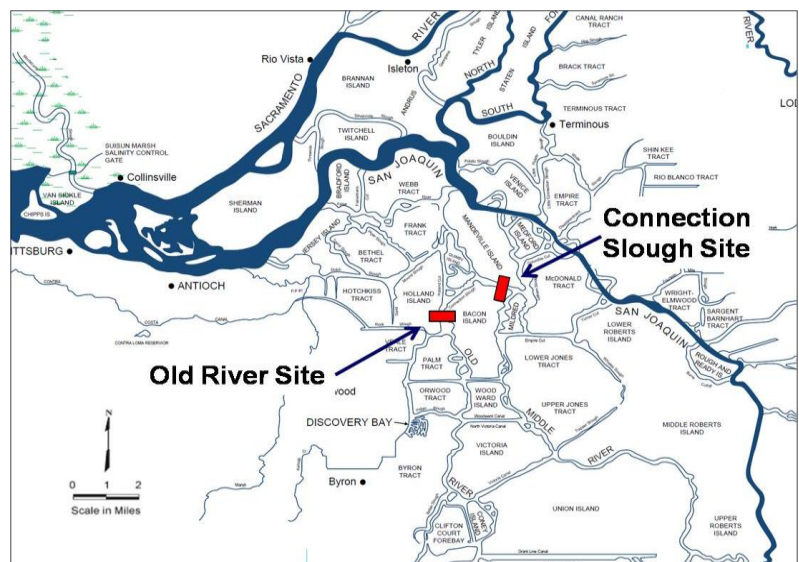
<sup>2</sup> [http://baydeltaoffice.water.ca.gov/sdb/sdip/index\\_sdip.cfm](http://baydeltaoffice.water.ca.gov/sdb/sdip/index_sdip.cfm).

biological opinions. A team comprised of staff from MWD<sup>3</sup>, State Water Contractors, CVP contractors, and Contra Costa Water District formed in 2008 to expedite implementation of the project and initiate the environmental documents<sup>4</sup>; the USBR is serving as the project proponent for purposes of environmental review.<sup>5</sup>

The project would use operable gates to modify flows in the central Delta. The justification for the 2-Gates project relies on an observation that high turbidity (in excess of 12-15 NTU) is correlated with and may be a functional cue for the annual spawning migration by delta smelt from Suisun Bay to the Delta, although this theory has only been specifically addressed to date in one peer-reviewed scientific paper (Grimaldo et al. 2009). During high river flow periods, turbidity enters the western Delta from the Sacramento River and the central Delta via Georgiana Slough, and the south Delta through Old River and Middle Rivers. Inflow from the San Joaquin River also contributes a pulse of turbidity, although the timing typically lags behind that from the Sacramento River. When these

two water bodies meet, they form a continuous high turbidity zone which presumably encourages smelt to move south toward the pumps. In the 2-Gates Project, temporary gates would be placed across Old River and Connection Slough in the Central Delta, and operated December-March to

*The 2-Gates Project...has been proposed as a 5-year adaptive management experiment to justify higher minimum export volumes than outlined in the USFWS and NMFS biological opinions.*



keep turbid water away from the export pumps. The purpose of the project is to demonstrate that operable gates, in conjunction with some restriction on negative OMR flows, could provide equal or greater protection for delta smelt than restrictions on reversing flow in Old and Middle rivers.

The CALFED Science Program convened an Independent Review Panel in August 2009 to review the 2-Gates Project Summary Document (MWD 2009, Anderson et al. 2009). The draft environmental assessment for the project was released for review in October 2009 (USBR 2009a, b). One of the California

<sup>3</sup> See minutes of June 9, 2009 MWD Board of Directors meeting and related letter to MWD Board of Directors from Water Planning and Stewardship Committee dated June 9, 2009.

<sup>4</sup> See December 2008 "Bay-Delta Management" report to the MWD Board of Directors.

<sup>5</sup> [http://www.usbr.gov/mpnepa/nepa\\_projdetails.dfm?Project\\_ID=4472](http://www.usbr.gov/mpnepa/nepa_projdetails.dfm?Project_ID=4472)

Senate bills in the comprehensive water package passed in November 2009 (SBX7-1, Delta Governance/Delta Plan) appropriates funding from Proposition 84 to fund the 2-Gates Fish Protection Demonstration Program.

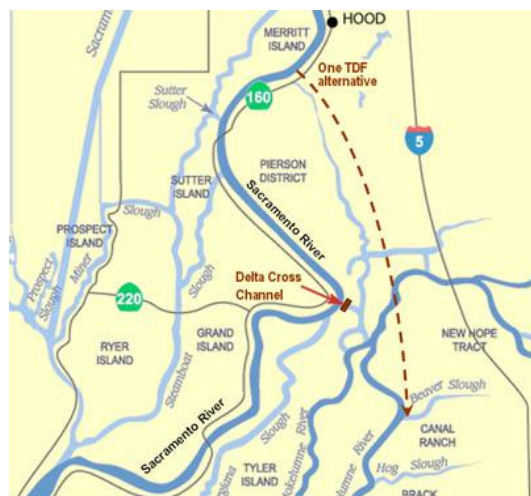
Some of the objections raised regarding the 2-Gates project are:

- (1) That submission of environmental documents consisting of a Finding of No Significant Impact and Mitigated Negative Declaration (as opposed to a full EIS/EIR) is inappropriate for a project whose purpose is to keep an endangered species out of a part of its critical habitat;
- (2) Evaluations of potential impacts to other species (salmon, steelhead, sturgeon, longfin, splittail, threadfin shad, striped bass, etc.) have been cursory, or nonexistent;
- (3) Required authorizations (i.e., Clean Water Act section 404 & 401 permits, streambed authorization agreement, consistency determinations with federal biological opinions, etc.) are on a fast track; and
- (4) RPA IV in the 2009 NMFS biological opinion denied use of similar operable OMR barriers when it prohibited implementation of the South Delta Barriers Improvement Program (Action IV.6).

### ***Re-Operation of Delta Cross Channel Gates***

The Delta Cross Channel (DCC) was constructed in 1951 to assist in transferring water from the Sacramento River across the Delta. When the gates are open, Sacramento River water is diverted into the north and south forks of the Mokelumne River, and

toward the south Delta pumps. Adult Chinook salmon use the Sacramento River, DCC, and Georgiana Slough as out-migration pathways. A major effect of water operations in the Delta is diversion of out-migrating juvenile salmon from the north Delta tributaries into the interior Delta when the DCC gates are open. Instead of migrating directly to the outer estuary and then to sea, juvenile salmon are caught in the interior Delta and subjected to predators, and altered food webs, and other stressors that may cause direct mortality or impair growth. Investigations in the early 1980's indicated that juvenile winter-run Chinook salmon may be entrained into the interior Delta in proportion to Sacramento River flow diverted through the DCC (Shaffter, 1980). In order to protect out-migrating winter-run Chinook salmon, the DCC gates are operated in accordance with Water Rights Decision 1641 (SWRCB 2000), requiring closure of the gates between February 1-May 20, and intermittent closures of proscribed total duration outside of that period when requested by the USFWS, NMFS, or CDFG for fisheries protection.



**Delta Cross Channel (DCC) location**



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The Preferred Program Alternative described in the CALFED (2000) Record of Decision (ROD) included re-operation of the DCC as one of two north-Delta conveyance facilities improvements (the other was a proposed Through Delta Facility [TDF]). In 2001, the CALFED Science Program began a study of the effects of DCC gate operations and tides on flow and fish entrainment. An evaluation by scientists with DWR and DFG found a significant linear relationship between the proportion of Sacramento River flow diverted into the interior Delta and the proportion of the winter-run Chinook salmon population lost at the Project facilities between October and May of each year from 1995-2006 (Low et al., 2006). The study authors concluded that the strength of the observed relationship provided sufficient justification for changes in the decision criteria for DCC gate closures.

From November 2008-February 2009, DWR conducted a study of out-migrating Chinook salmon smolts on the Sacramento River.<sup>6</sup> The salmon investigation was designed to:

- (1) Generate a regional database of out-migration movement, flows, and salinity, leading to a statistical analysis of route selection behaviors and reach specific survival rates; and
- (2) Acquire a 3-dimensional array of salmon and hydrodynamic data at the Sacramento River junctions of Georgiana Slough and the DCC.

Among other things, the study involved releases of acoustically-tagged fish with different DCC gate operations scenarios. A

CALFED Independent Science Review Panel expressed many concerns with the experimental design (Monismith 2008). Among the panel's comments was that the structure of the review was "somewhat extraordinary (i.e., reviewing a proposal that the funding agency had apparently already selected for funding via a sole-source selection process)." No report is yet available for the study.

**New federal rules imposed in 2009 by the NMFS biological opinion for CVP and SWP operations now require the gates to be closed starting in October for at least three days whenever young salmon are present in the Sacramento River, and during more of the period November-February than was previously required under Water Right Decision 1641.**

### **Screens and Ladders at Delta Diversion Points**

#### ***Fish Screens***

The Preferred Program Alternative outlined by CALFED agencies in the CALFED (2000) ROD recommended that new fish screens be designed and constructed at the Clifton Court Forebay and Tracy Pumping Plant facilities to allow the export facilities to pump at full capacity more regularly. The proposed schedule was:

- Complete funding plan by early 2003.
- Complete facilities design by the middle of 2004.
- Seek funding and authority to complete initial fish screens, and begin operations and performance testing by the middle of 2006.
- In addition, fish screens would be a necessary element of the Through-Delta facility proposed in the CALFED ROD.

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<http://baydeltaoffice.water.ca.gov/ndelta/salmon/index.cfm>.

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### *Lack of Progress on Fish Screens*

By the end of the very first of the post-ROD years (2000-2001), the CALFED Conveyance Program elements for installing fish screens at the Clifton Court Forebay and Tracy facility had already been put on “hold” for “reevaluation” of “scope and schedule” (see Schedule on page 11 in CBDP, 2003). By 2004, the CALFED activity related to fish screens was still on hold, and a new hydrodynamic study appeared to have taken its place as a CALFED action item (CBDP 2005, p. 10).

In the “Accomplishments” section of the 2006 annual plan (CBDP 2006), the scope of the hydrodynamic study referred to above was revealed to include food web components, but not to include research applicable to the design or construction of fish screens (CBDP 2006, p. 6).

After 2005, research priorities related to direct mortality of entrained fish appeared to have mostly shifted toward Capture, Handling, Trucking, and Release aspects of the existing salvage operations (CBDP 2007, p.6). And finally, by 2008, the original project area designated for work on fish screens was renamed from “Clifton Court Fish Screens” to South Delta Fish Facility Improvements (CBDP 2008).

In summary, CALFED apparently abandoned its explicit commitments for installing fish screens at the south Delta diversion points at the very beginning of the post-ROD CALFED program, and as of 2009, had not resurrected fish screens as a CALFED action item or serious subject of research (CBDP 2009).

### *Fish Ladders for a Proposed Through-Delta Facility*

A potential Through-Delta Facility<sup>7</sup> was one of the two north-Delta conveyance facilities improvements included in the Preferred Program Alternative in the 2000 CALFED ROD. The TDF is a proposed screened conveyance which would pump up to 4,000 cfs from the Sacramento River into the Mokelumne River (SVS 2007). This project is distinct from the isolated alternative conveyance currently proposed by the Bay-Delta Conservation Plan (BDCP) because the diverted water would not be delivered directly to the south Delta pumps, but would be discharged into the central Delta. The objective of the proposed diversion is to reduce salinity at the south Delta export locations. Several potential alignments have been studied by DWR consultants.

Were the TDF to be built, anadromous fish migrating upstream from San Francisco Bay could get miscued by Sacramento River water passing into the southern Delta through the TDF and attempt to move upstream toward the Sacramento River via the San Joaquin and Mokelumne Rivers. Upstream migrants which do not find their way back to the Sacramento River via Three Mile Slough, Georgiana Slough or the Delta Cross Channel could be attracted by the TDF discharge. For these migrants, the TDF would serve as a physical barrier. The TDF would need upstream passage facilities for sturgeon and other anadromous fishes in order to ensure their ability to spawn upriver.

The southern distinct population segment (DPS) of the green sturgeon (*Acipenser medirostris*) was listed as threatened under

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<sup>7</sup> <http://baydeltaoffice.water.ca.gov/ndelta/TDF/>.

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the ESA in 2006 and is one of the anadromous species in the Delta that is addressed by the 2009 NMFS biological opinion on the SWP/CVP operations. Owing to their large body size and tendency to remain near the bottom, sturgeon require completely different kinds of fish ladders than salmonids. The DWR Fishery Improvements Section conducted a feasibility/design study for a sturgeon ladder using white sturgeon between 2003-2005 (*Through-Delta Facility White Sturgeon Passage Ladder Study*, Wilde 2007).

### Non-Physical Barriers

In May 2009, DWR tested an experimental, non-physical fish barrier for juvenile Chinook salmon and steelhead<sup>8</sup> near the head of the Old River. The barrier combines acoustics and a strobe-lit sheet of bubbles to create an underwater wall of light and sound at frequencies that repel salmon smolts. The bubble-curtain was being tested as a replacement for the HORB to help keep juvenile salmon from straying into Old River as they out-migrate from the San Joaquin River through the Sacramento-San Joaquin Delta. The installation of the spring HORB did not take place in 2009 because of a court order related to the USFWS 2008 biological opinion for delta smelt. VAMP participants decided to test the strobe-lit, sound-generating bubble curtain as an alternative to the rock barrier, which can have adverse hydrodynamic impacts on delta smelt.

Seven releases of hatchery juvenile Chinook salmon implanted with acoustic tags were planned during the pilot study to evaluate their response to the bubble barrier. As of

mid-May 2009<sup>9</sup>, preliminary data from the first three releases suggested that the bubble curtain had increased the number of smolts staying in the San Joaquin River during their out-migration to San Francisco Bay and the ocean. However a large percentage of the smolts that were deterred from entering Old River were eaten by striped bass that were patrolling in the vicinity of the bubble curtain (CALFED Science News, December 2009<sup>10</sup>).

### Mitigation of Pre-Screen Losses in Clifton Court Forebay

#### *Alteration of Herbicide Applications*

At certain periods of time, build up of pondweed at the Skinner Fish Facility can result in pumping restrictions. To control this, DWR has applied Copper-based herbicides such as Komeen® in Clifton Court Forebay since 1995, typically during the spring or early summer when listed salmonids have been present in the forebay. These herbicide applications present toxicity issues to salmonids and green sturgeon due to their high sensitivity to copper at both sub-lethal and lethal concentrations. Exposure of green sturgeon to herbicides in Clifton Court Forebay was one of four categories of effects of the Delta Division of SWP/CVP OCAP evaluated by the NMFS (2009) biological opinion. DWR, in response to NMFS' concern over the use of Komeen® during periods when listed salmonids may be present in the Clifton Court Forebay, has altered its operational

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<sup>8</sup> Press release, photos, and video are available at <http://www.water.ca.gov/news/archive/>.

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<sup>9</sup> May 18, 2009, DWR press release, available at: <http://www.water.ca.gov/news/archive/index.cfm?yr=2009>

<sup>10</sup> Available at [http://www.science.calwater.ca.gov/publications/sci\\_news.html](http://www.science.calwater.ca.gov/publications/sci_news.html)

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procedure for application of copper-based herbicides from previous operations (NMFS 2009). DWR now proposes to apply copper sulfate or Komeen® only between July 1- August 31 of each year as needed. Other mitigation steps proposed by DWR include the following actions:

- Monitor the salvage of listed fish at the Skinner Facility prior to the application of the herbicides in Clifton Court Forebay;
- Close the radial intake gates at the entrance to Clifton Court Forebay 24 hours prior to the application of herbicides to allow fish to move out of proposed treatment areas and towards the salvage facility;
- Keep the radial gates closed for 24 hours after treatment to allow for at least 24 hours of contact time between the herbicide and the treated vegetation in the forebay. Reopen the gates after a minimum of 48 hours.

Implementation of the shortened period of Komeen® application is scheduled to begin during the summer of 2010.

### ***Predator Removal Studies***

Predator removal investigations were conducted in the 1990's to reduce predation by striped bass in Clifton Court Forebay. As part of the Interagency Ecological Program studies, the DFG estimated that in March 1993, the total striped bass population in the forebay was around 200,000, even after almost 29,000 striped bass were removed in a pilot predator removal program (Brown et al., 1996). The high loss estimates of fish due to striped bass predation in the forebay caused interest in a program to reduce losses by catching striped bass using nets and hauling them for release in San Pablo Bay or other locations far from the forebay, which

was planned for 1994. However, opposition from angler organizations caused the program to be postponed, and in the meantime, results of an acoustic tagging program indicated that striped bass move freely through the radial gates to the Delta, indicating that the effectiveness of planned removal programs may be limited. In the mid-1990's, DWR and DFG were planning studies to further confirm that striped bass move freely between the forebay and the Delta (Brown et al., 1996).

### ***Salvage Mortality***

A number of investigations have been conducted into the mechanisms and factors affecting fish survival during the salvage process at both the SWP and CVP fish salvage facilities. The USBR began a Tracy Fish Facility Improvement Program (TFFIP)<sup>11</sup> in 1989. Since then, the TFFIP has implemented a predator removal program, holding tank surveys, secondary louver netting programs, fish egg and larvae entrainment estimates, updated louver efficiency estimates, improved fish handling and identifications, "fish friendly" pumping system, and a "fish friendly" mitten crab removal system (traveling screen). Over three dozen TFFIP reports are posted on-line at: [http://www.usbr.gov/pmts/tech\\_services/tracy\\_research/tracyreports/index.html](http://www.usbr.gov/pmts/tech_services/tracy_research/tracyreports/index.html).

Recent Collection, Handling, Transport and Release research for the SWP's Skinner Facility salvage operation has included an "Element 2" study to assess post-release predation mortality at SWP's Horseshoe Bend release site, and an "Element 3" study to measure injury and mortality associated

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[http://www.usbr.gov/pmts/tech\\_services/tracy\\_research/index.html](http://www.usbr.gov/pmts/tech_services/tracy_research/index.html).



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with the release of fish from the tank trucks. Element 2 monitoring was scheduled August 2007-April 2008; techniques included Dual Frequency Identification Sonar (DIDSON) camera monitoring, hydroacoustics, acoustic telemetry, avian predation monitoring, and electrofishing. In the Element 3 study in 2007, delta smelt and juvenile Chinook salmon were released through a mock-up of the SWP release site into a receiving tank representing the receiving water body so that injury and mortality could be measured over a 48-hour mock post-release period. Reports have not been released yet for either study, so it is difficult to know whether the NMFS estimate above 12-32% would apply to delta smelt, as well as salmon smolts.

### **Proposed BDCP conservation measures that address fish loss**

The proposed BDCP includes conservation measures in draft Chapter 3 to address predation of covered fish species and non-physical barriers to re-direct fish away from channels where survival is low. **The BDCP does not propose improvement, enhancement or replacement of the fish screens or salvage facilities in the south Delta, despite the fact that losses are ongoing and will continue into the future with the continued operation of these facilities.**

#### **Predator Controls**

BDCP conservation measure OCSM24 aims to “reduce the effects of predators on covered fish species by conducting localized predator control of high predator density locations.” Predation has been identified as a stressor to covered fish species, and the BDCP recognizes that particular habitat

conditions are conducive to predators. The conservation measure aims to identify the locations of predator hot spots, which are theorized to include areas that favor predators such as deep holes, shaded areas around docks and marinas, abrupt depth changes, and release sites for salvaged fish from CVP/SWP facilities. The conservation measure proposes that methods such as modification of channel geometry and targeted removal of predators could be used to control predator populations. Interestingly, Clifton Court Forebay is not specifically mentioned, despite being known for decades to be a hot spot for predation of covered fish species. In addition, the fact that permanent operable gates, such as were prohibited in the 2009 NMFS biological opinion, are known predator hot spots, is not mentioned in draft Chapter 3 of the BDCP. This is noteworthy because the operable gates proposed for testing in the 2-Gates Demonstration Project form the basis for BDCP Conservation Measure WOCMN8.

#### **Non-Physical Barriers**

BDCP conservation measure OCSM25 proposes to “improve survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower.” The proposed barriers would consist of sound, light and bubbles, such as were used in the 2009 DWR “bubble curtain” at HORB previously described. The list of potential locations for barrier installation includes Clifton Court Forebay. However, as explained previously, it is now known that non-physical barriers – such as bubble curtains – can serve as predator hot spots.

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## Moving Forward...

There is a large body of evidence that indicates that high percentages of covered fish species are lost due to SWP and CVP pumping operations in the south Delta. As captured in the above discussion, information indicates that the direct loss of various species of fish in and around the south Delta pumping facilities is significant, historic, and ongoing. Studies showing high mortality date back to the 1970s. Mitigation efforts to reduce losses have been suggested repeatedly over the past two decades but have either not been implemented or have been shown to not be successful. Population level effects from mortality due to pumping operations are potentially significant.

In contrast, evidence of direct loss of fish attributable to adverse water quality conditions; agricultural, stormwater and wastewater discharges, is generally lacking.

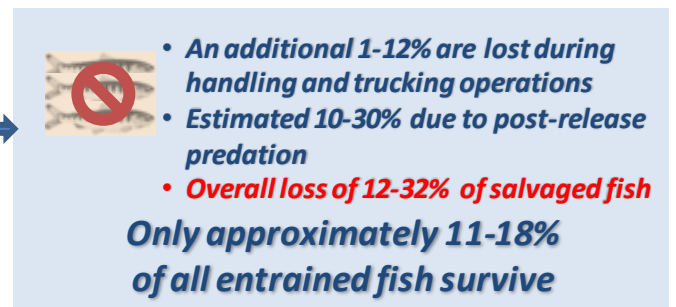
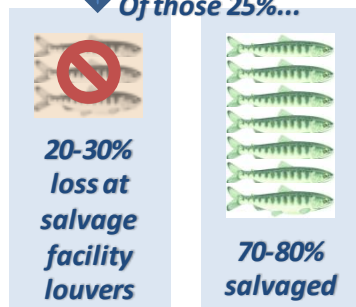
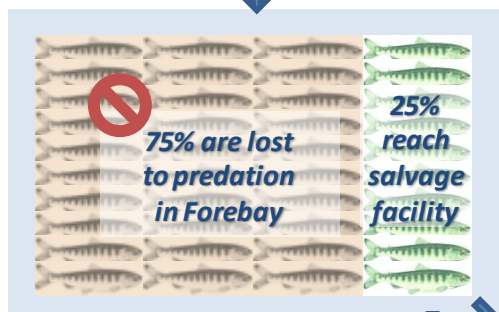
*Studies showing high mortality date back to the 1970s, and mitigation efforts to reduce losses have been suggested repeatedly over the past two decades. Population level effects from mortality due to pumping operations are potentially significant.*

As seen in the mitigation section of this paper, recent mitigation actions to protect fish from pumping operations primarily focus on physical devices such as gates. Less attention has been focused on improving fish screens, despite that being noted as a priority mitigation area in reports dating back to the mid 1990s. Little has been done to prevent fish from entering Clifton Court Forebay or to reduce the effects of predation.

### Data and Research Gaps

In terms of the direct loss of fish, clearly more effort is needed to develop feasible measures to reduce the ongoing loss of listed species that are entrained as a result of SWP and CVP operations.

In terms of indirect losses, the science supporting various hypotheses that have been offered (food web disruption, sublethal toxicity, proliferation of nuisance aquatic species) is less clear, and continued research is needed to explore the validity of those hypotheses. It is interesting to note the level of interest that has been generated in the past several years around specific indirect stressors (ammonia, pyrethroids, endocrine disruptors, nutrients) that are not associated with Delta export operations. In contrast, there has not been a similar interest to examine the indirect effects associated with the loss of nutrients, phytoplankton and zooplankton from the Delta and the modification of hydrodynamic and habitat regimes in the Delta due to export operations. More research is needed to investigate the extent to which fish populations are impacted as a result of altered hydrodynamic conditions. Indirect losses of fish due to pumping operations may be large, but have not yet been quantified. Mark-recapture investigations were intended to study indirect losses, but have not provided insight into the magnitude of indirect losses (Kimmerer, 2008).



## Graphical Depiction of Loss/Survival Rate of Entrained Fish

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